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ABSTRACT

The print-based model of distance education through correspondence continues to be used, but is being supplemented and, in some cases, replaced, by other media. A second generation of distance education in the 1960s and 1970s was characterized by reliance on open broadcasting, supported by correspondence instruction and print materials. A third generation has been characterized by teleconferencing systems, and society is now entering a fourth phase of development of distance education based on the integrated use of new developments in telecommunications and computing, characterized by the integrated use of remote study materials supported by computer-based multimedia teleconferencing. New technologies are ensuring that it will be possible to adapt to telecommunications-based communication easily and at acceptable cost. Research suggests that these new technologies are capable of delivering effective instruction. One potential benefit of the integrated networks is that they may be user-driven, with groups of students forming because of common interests and with instruction responding rapidly to the demands of society. (Contains 23 references.) (SLD)

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Developments in Telecommunications

Recently a growing number of distance education institutions throughout the world have been utilizing telephone tutorials and audio conferences to supplement print-based interactions (Parker & Olgren, 1984; Garrison, 1990). A characteristic of this means of distance education by telephone is that communication is *synchronous* in nature. That is, the participants in the discussion or the tutorial are online at the same time, although they may be separated by distance.

Recent developments in telecommunications technologies such as fax machines and electronic mail through computer networks have introduced a new element in the form of rapid *asynchronous* communication. This has the characteristic of the participants being separated in time, even if not necessarily by distance. This form of communication is destined to play an increasingly significant role in future distance educational systems (Mason & Kaye, 1989; Kaye, 1992; Soby, 1992; Cheng, Lehman, & Reynolds, 1991).

Another aspect of progress in telecommunications is increasing capacity and greater standardization of electronic communication media. Increasing capacity is a result of the widespread availability of satellites for long distance communication and the gradual replacement of copper wires by fiber optic cables of greater capacity. Standardization is being promoted by the gradual implementation of a worldwide Integrated Systems Digital Network (ISDN). The ISDN network will be capable of carrying all types of messages, whether they are in the form of audio, video, text, or computer data, through the same channels in the same digital format. This will enable the messages to be integrated at end user terminals into multimedia presentations (Brewster, 1987; Malfitano & Cincotta, 1992; Heler, Cooley, & Reitz, 1993). This is the impetus for most of the developments in distance education.

Developments in Distance Education

The print-based model of correspondence education supported by distance instruction through written messages has survived the test of time and continues to be utilized intensively. However, as distance education has become more institutionalized, other media have been applied. A "second generation" of distance education through the 60s and 70s was characterized by heavy reliance on open broadcast by either radio or television, supported by correspondence instruction and print materials.

The "third generation" of distance education has been characterized by teleconferencing systems. These began with audio conferencing but progressed to more sophisticated audiographic conferencing systems that supported the telephone audio conference with visual and text material (Barker & Goodwin, 1992). Another parallel development has been video conferencing. Until recently this was a somewhat expensive alternative to the audio conference, but due to developments in digital computer-based desktop video, it is now becoming economically accessible to an ever larger section of the educational community (Parker & Olgren, 1984; Tremblay, 1992).

We are now entering a fourth phase of development of distance education based on the integrated use of new developments in telecommunications and computing and characterized by the integrated use of remote study materials supported by computer-based multimedia teleconferencing (Steinberg, 1992). Integrated multimedia computer technology will provide the platform which will most resemble real-time, interactive instruction.

The Technologies

The various technologies available for telecommunications-based distance education can be schematized as in the figure below. In the synchronous communication mode, we are witnessing a development from predominantly audio communication by telephone, or amplified telephone in the case of audio conferences, to multimedia interactive real-time communication, either between individuals or groups. The result is that virtually all of the activities that can be undertaken in a conventional classroom situation can also be undertaken over distance, in a form of "virtual reality" (Hiltz, 1990). In the asynchronous communication mode, the predominant medium of the past (print) is being supplemented by voice messaging facilities and other graphic communication potential so that once more we are working towards an integrated multimedia environment for educational communication. According to Hiltz and Turoff (1978), Vallee (1982), Kearsley (1985), Grief (1988), and Wilkinson and Sherman (1991), we are rapidly becoming a networked society that will adapt to utilizing telecommunications-based communication as easily as face-to-face communication is utilized in society today.

	SYNCHRONOUS COMMUNICATION	ASYNCHRONOUS COMMUNICATION
ONE ON ONE	Telephone ↓ (Videophone) ↓ Multimedia Workstation	Facsimile ↓ E-Mail ↓ (Voicemail) ↓ Multimedia Workstation
GROUP LEARNING	Audioconference ↓ Audiographic System ↓ Videoconference ↓ Virtual Classroom	Computer-Conference ↓ Computer-Supported Collaborative Work (CSCW) Environments ↓ Multimedia Network

ED 361 169

Costs

The telecommunications option for education is often perceived as being expensive compared to either face-to-face education or the more conventional distance education methods based on print and correspondence by mail. However, this is not a completely accurate perception. Cost calculations that include the communication costs as well as the costs of tutor time in generating feedback messages to students show that telecommunications-based instruction can be more cost efficient than print-based instruction (Romiszowski & Iskandar, 1992). The experience of AT&T in utilizing audiographic teleconferencing has demonstrated cost reductions of over 50% in the real costs of training if these are calculated to include the cost of transport and accommodations of participants from remote sites (Chute, 1988). Furthermore, the costs of telecommunication are falling whereas the costs of educational space, staffing and transport are rising, so that over time the economical equation will favor the increased use of telecommunications-based education. One should also remember that over the long view it will not be necessary for educational systems to invest in the basic infrastructure for telecommunications as this is a requirement for society and business in general (Zuboff, 1988; Johansen, 1988).

Potential Benefits

Given the technological scenario for the future that has just been painted, it is fair to ask whether such future systems are capable of delivering an appropriate level of quality of education. Research on distance education by and large has shown that, when appropriately planned, distance education can be as effective as conventional classroom based education. While there are some exceptions in terms of certain types of content or certain groups of students, the move towards integrated multimedia networking may be expected to extend the range of effective distance education applications (Collis, 1991; Steinberg, 1992; Kaye, 1992).

One potential benefit of such integrated networks in distance education is that they may be "user driven." Groups of students may form naturally because of common interests at a given point in time, largely independent of decisions made by any single educational institution. A program of study might be composed of modules of materials pulled in from various institutions as required by the particular individual or group. Potentially, such a development offers the promise of overcoming a major weakness of conventional educational provision, namely the long reaction time required by institutions to adapt curricula and content to the changing needs of society. To extend the currently popular hypertext/hypermedia jargon, we might look forward to the hyper-school or hyper-university, a network of the world's educational institutions that may be browsed at will by a student interested in planning and following through an individual program of study.

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